Model C-50
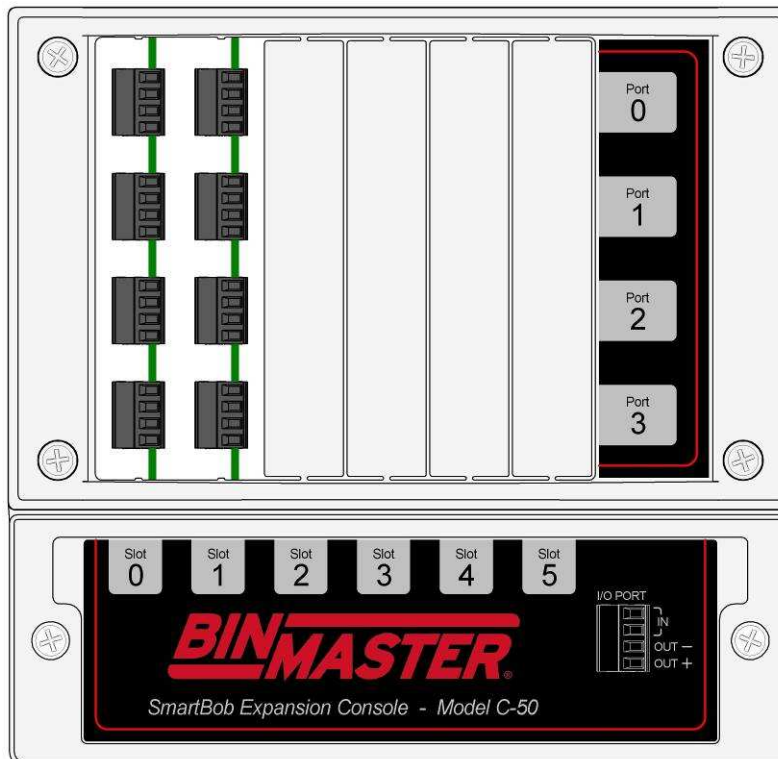# SmartBob Expansion Console

OPERATORS MANUAL
Please read thoroughly before installation and operation.

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TABLE OF CONTENTS

Safety Summary

Review the following safety precautions to avoid injury and prevent damage to the equipment.

The product should be installed, commissioned, and maintained by qualified and authorized personnel only.

Install according to installation instructions and comply with all national and local codes.

Use electrical wire that is sized and rated for the maximum voltage and current of the application.

Insure that the enclosure covers are in place and secured tightly during normal operation.

If this product is used in a manner not specified by the manufacturer the safety protection could be compromised.

Safety Terms and Symbols

WARNING: Warning statements identify conditions or practices that could result in injury or loss of life. Risk of electrical shock.

CAUTION: Caution statements identify conditions or practices that could result in damage to this product or other property.

FCC Compliance

NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

1.0 Introduction

The BinMaster Model C-50 is an expansion console for interfacing a SmartBob system to other types of systems, such as a PLC or DCS system. The C-50 is configured and controlled by the model C-100 SmartBob control console via a dedicated RS-485 line, with up to five C-50 SmartBob expansion consoles being supported by the C-100.

The C-50 SmartBob expansion console supports up to six I/O cards. A single I/O card contains four I/O ports where the input is used for triggering a measurement process and the output provides for an analog 4-20mA current source representing the results of that measurement. With five C-50 SmartBob expansion consoles being supported, a complete SmartBob system with 120 sensors is supported.

2.0 Specifications

Power Requirements
  Isolated 24 VDC with 8W minimum for up to three installed cards and 16W minimum for more than three installed cards.

  A quality earth connection is also required on the power terminal. Although this is not needed for power or normal operations, it is required for proper protection from lightning and other electrical surges.

Expansion Network
  RS-485 at 19,200 bps using a proprietary half duplex protocol on up to 4,000 feet of a quality twisted-pair shielded cable.

Maintenance Connection
  RS-232 using various speeds and protocols for Flash updates and maintenance.

External Start Input on I/O Card
  Continuous monitoring for a dry contact closure to initiate a measurement with a response time of less than 6 sec.

4-20mA Current Output on I/O Card
  Continuous 4 – 20mA current output with 0.244µA of resolution into a maximum load resistance of 825Ω with an accuracy of +/-0.15% of its programmed value.

  If weight calculations are disabled, the output level is relative to the last measurement of a user-assigned vessel and its entered height. If weight calculations are enabled, the output level is relative to the calculated weight of a user-assigned vessel and all its entered parameters. Error conditions of 2mA or 22mA can also be presented at this output, depending on user settings at the C-100 SmartBob control console.

Ambient Temperature
  Storage: -4° to 158° Fahrenheit (-20° to 70° Celsius)
  Operating: -4° to 140° Fahrenheit (-20° to 60° Celsius)

Physical
  Dimensions: 6.5 x 6.3 x 3.5 inches (166 x 160 x 89 mm)
  Weight: 1.8 lbs (0.8 kg) maximum
  Enclosure: Polycarbonate, light industrial gray.

Ingress Protection Rating   NEMA Type 1, IP40

3.0 Installation

3.1 Mounting

When locating a position to mount the C-50 SmartBob expansion console, make sure to allow for adequate air flow around the unit and don't place it near any equipment that produces excessive heat. If the ambient temperature of the C-50 is going to exceed 104°F (40°C), consider using a fan of some type to circulate the air.   Allowing for good air flow around the C-50 will prolong the life of the unit.

There are two options for mounting the C-50 SmartBob expansion console: by DIN rail or by mounting screws.

3.1.1 DIN Rail Mount

An optional kit may be purchased for mounting the C-50 SmartBob expansion console to a DIN rail.

3.1.2 Screw Mount

There are three screw holes that can be used for mounting the C-50 SmartBob expansion console as shown in the diagram below. You will need one #8 wood screw at least 3/8" long and two #8 wood screws at least 5/8" long.

1. Locate, drill a hole for and screw the 3/8" long screw into the mounting board/plate, leaving the head of the screw out about 1/8".
2. Hang the console with the one screw by the center mounting tab.
3. Remove the lower wiring cabinet cover and mark the locations for the two lower mounting screws with a pencil or awl.
4. Remove the console and drill holes for the two lower mounting screws.
5. Hang the console again by the center mounting tab and fasten in place with the two lower mounting screws.


4-3/4"

5-15/16"
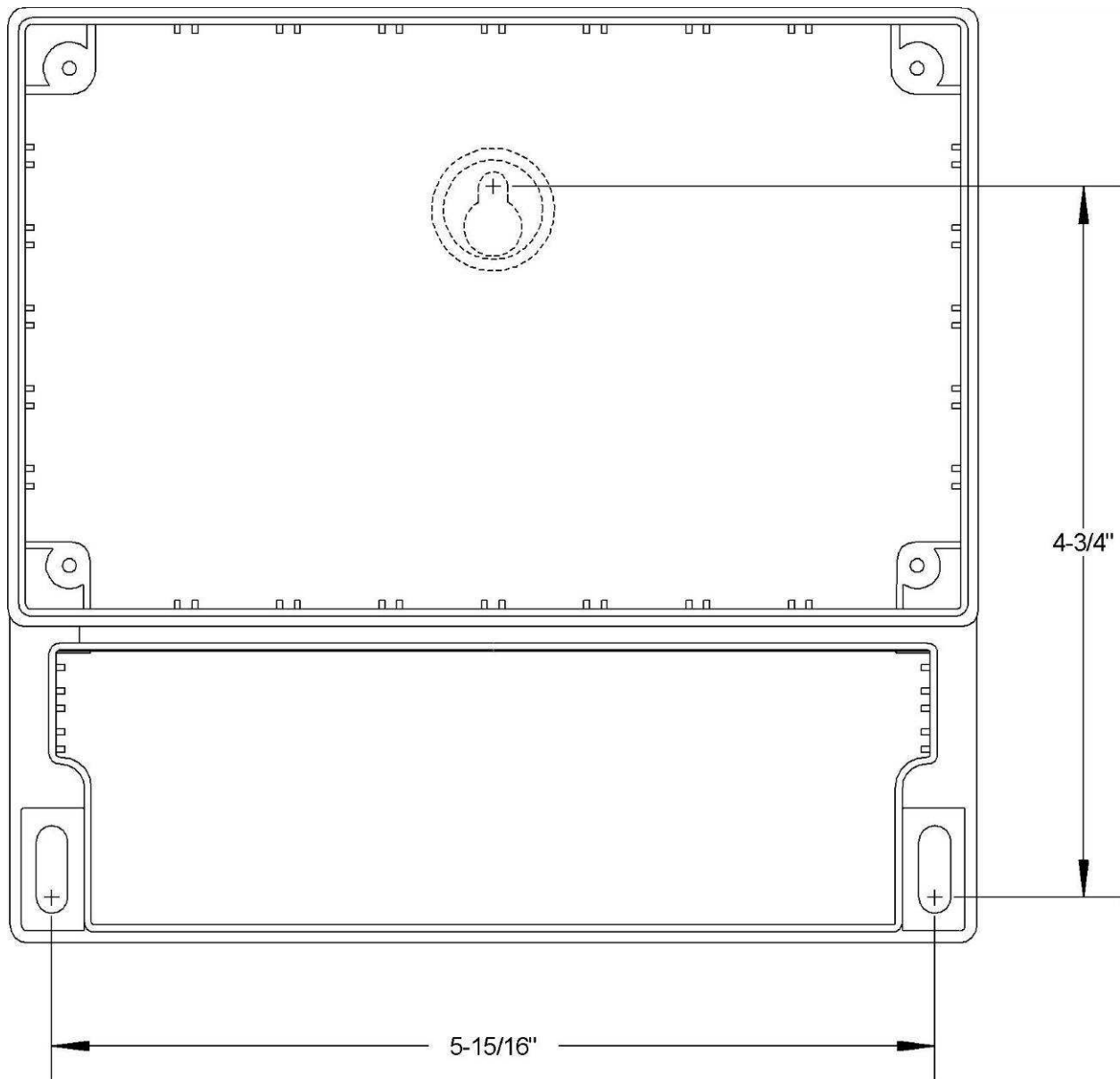
3.2 Installing Cards

The C-50 SmartBob expansion console contains 6 slots for supporting up to 6 cards. Carefully follow the instructions below for installing a card into the base unit. Also, reference any instructions that are included with the shipment of the card.

⚠ **CAUTION:** Disconnect the power from the console prior to installing or uninstalling cards. Installing or uninstalling cards with power applied to the console may result in damaged equipment.

1. Disconnect the power from the console.

2. Unfasten the four screws supporting the upper compartment cover to the C-50, remove and set aside.

3. As illustrated below, take a card to be installed and vertically align it within the slots inside the C-50 enclosure. Carefully slide the card all the way back and gently seat it into the back connector.

4. Install other cards in the same manner. The cards may be placed in any of the six slots on the left and in any order.

5. Break away the knockouts from the cover for the slot positions being used.

6. After verifying that all cards are properly aligned in the slots and fully seated into the back connector, place the front cover in position and fasten with the four screws. Do NOT over tighten.
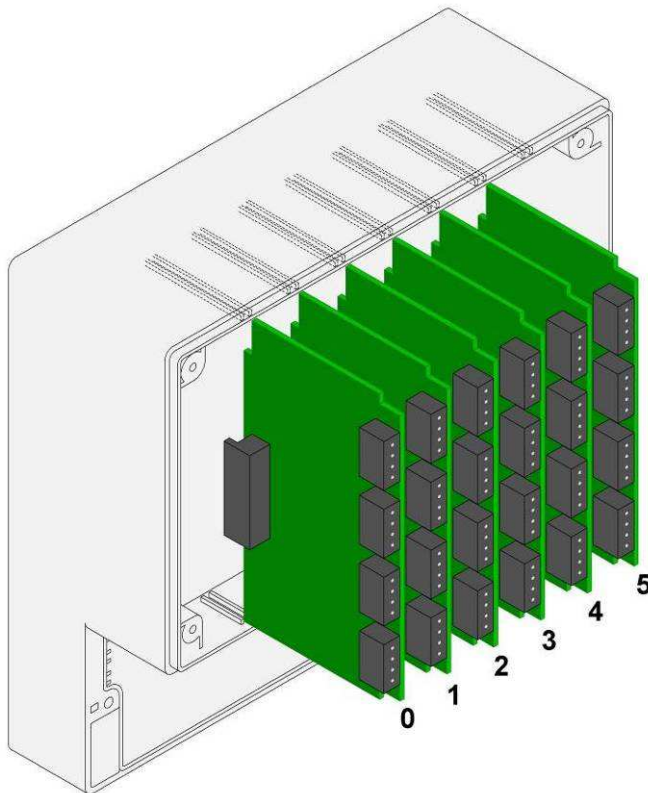
3.3 Connections and Wiring

A minimum configuration will require a three-wire power connection and a three-wire RS-485 connection to the Expansion (EX-485) network.

Power and RS-485 wiring is fed through cordgrips and connected inside the lower wiring cabinet to pluggable terminal blocks mounted on the printed circuit board. Remove the two screws on the lower wiring cabinet cover to gain access to the terminal blocks.

Both terminal blocks are capable of supporting 22 to 12 AWG size wires. Be sure to use the appropriate wire gauge/size for the connections and follow all national and local codes concerning this installation.

### 3.3.1 Power Connection
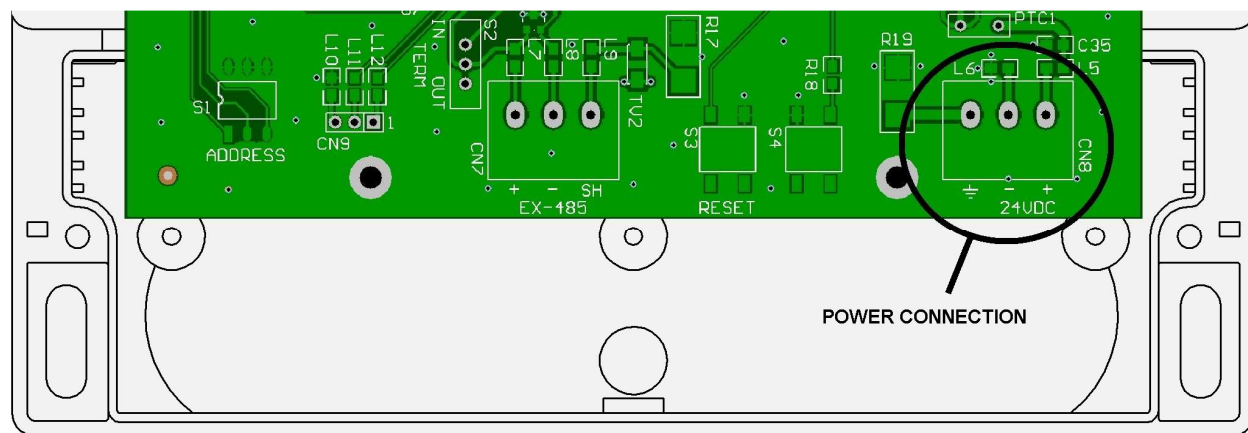
POWER CONNECTION

The power connection (CN8) is a three wire terminal block located on the far right. Two terminal screws marked + and – are for connecting to an isolated 24VDC power source. A 14 or 16 AWG wire would be sufficient for these two power connections.

The terminal screw marked with the $\perp$ symbol should be connected to a quality earth for proper protection from lightning and other electrical surges. It is recommended to use a 16 AWG wire or larger for the earth connection and connect it to the closest possible source to earth.

It is strongly recommended to use a separate power supply for powering each device connected to the Expansion network. This provides additional level of protection from lightning and other electrical surges.

All three connections at CN8 are required for proper operation and protection of the console.

3.3.2 EX-485 for Expansion Network
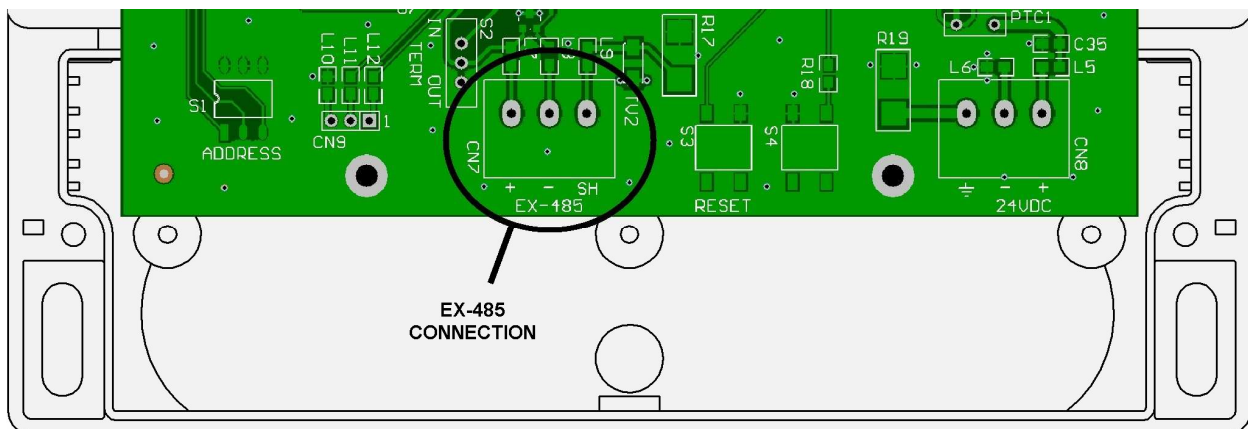
The EX-485 connection (CN7) is a three wire terminal block located near the center of the printed circuit board and is for connection to the RS-485 expansion network. Two terminal screws marked + and – should be connected to the positive and negative wires of the expansion network cable. The third terminal screw marked SH should be connected to the shield of the expansion network cable. Do NOT connect the shield to earth.

A good quality cable designed for RS-485 should be used for the expansion network. The cable should connect to each device on the expansion network in a daisy-chain fashion. Branch lines or splits are not recommended. The maximum length of the cable should be 4,000 feet or 1,220 meters.

Devices located at the ends of the expansion network cable must be properly terminated. The expansion network termination at the C-100 SmartBob control console is permanently switched in, so it must be located at one end of the network cable. If the C-50 SmartBob expansion console is located at the other end of the network cable, switch its termination to IN. For additional C-50 SmartBob expansion consoles not located at the end of the network cable, switch their termination OUT.

3.3.3 Slot:Port Matrix

The model C-50 SmartBob expansion console can accommodate up to 24 ports by the use of 6 cards, with each card supporting 4 ports. This creates a row-column matrix of ports that are referenced as *c*:*s*:*p*, where *c* is the expansion console's address, *s* is the slot number and *p* is the port number. Expansion consoles are addressed 1 – 5 in any order along the expansion network. At each expansion console and starting from the left, slots are numbered 0 – 5. At each slot/card and starting at the top, ports are numbered 0 – 3. Therefore, the upper-left most port at console address 1 is referenced as 1:0:0 and the lower-right most port at console address 5 is referenced as 5:5:3. This referencing is important to understand when assigning SmartBob sensors to ports at the model C-100 SmartBob control console.
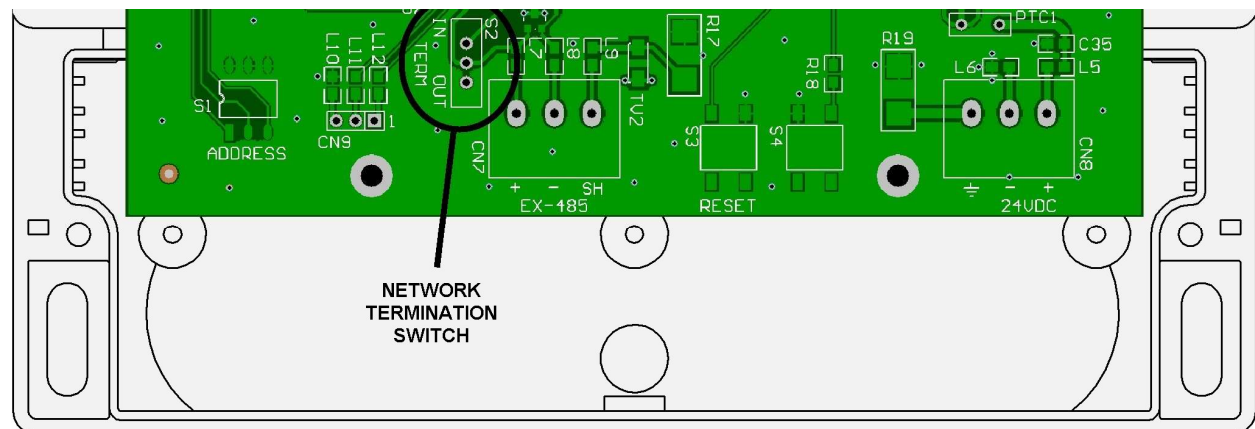
3.3.4 I/O Port
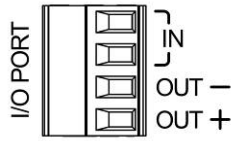
There are four I/O ports available on an I/O card (530-0596). Each I/O port consists of one pluggable terminal block with four terminals and can represent any one SmartBob sensor on the SmartBob network.

The input is the upper two terminals and is intended for connection to a dry contact, such as a pushbutton switch or a relay output from a PLC. This connection does not source or sink any negligible amount of current so a twisted-pair cable of 20 to 22 AWG wiring is sufficient. A shielded cable is not required; however, if one is used leave it un-connected at the console. A trigger occurs when this input is shorted and it must be cycled open in order to initiate another trigger.

The lower two terminals are for the analog 4-20mA output and are polarized as shown in the diagram above. The two terminals marked OUT- and OUT+ should be connected to the proper negative and positive wires of the load. This output is powered and capable of driving up to an 825Ω load. Depending on the distance this wiring must go, a quality twisted-pair cable of 18 to 22 AWG wiring is sufficient. A shielded cable is not required; however, if one is used leave it un-connected at the console. It is recommended to unplug all of the terminal blocks, fasten the wiring to the terminal blocks and then plug them in with power removed.

3.3.6 RS-232 Connection

This 3-pin connection (CN9) is only a temporary connection and should not be permanently wired. See the Firmware Updates section for more information about the use of this connection.

3.4 Switch Settings

The C-50 SmartBob expansion console's network address and termination switches must be properly set in order for reliable communications.

3.4.1 Termination Switch

If the expansion console is located at the end of the network cable the network termination switch must be switched IN, otherwise it should be switched OUT. The termination switch is labeled TERM and located under the lower compartment cover near the EX-485 terminal. Additional information is available under Section 3.4.2 EX-485 for Expansion Network and under Section 3.5 RS-485 Network Requirements.

3.4.2 Address DIP Switches

NETWORK ADDRESS
DIP SWITCHES

Up to five expansion consoles are supported on the expansion network (EX-485) and each must have a different address in the range 1 to 5. Use the table below to properly set the DIP switch array (labeled S1) located under the lower compartment cover to the far left. Any switch settings not shown below is invalid and will not allow the expansion console to function. On earlier hardware revisions, this switch array is located under the upper compartment cover between slots 3 and 4 on the main circuit board.

Address 1	ON – OFF – OFF
Address 2	OFF – ON – OFF
Address 3	ON – ON – OFF
Address 4	OFF – OFF – ON
Address 5	ON – OFF – ON

3.5 RS-485 Network Requirements

Both the SmartBob network (SB-485) and the Expansion network (EX-485) use RS-485 wiring and data signaling techniques and must meet certain criteria for reliable operation. If these criteria are not met, communications errors will most likely occur and result in failed measurements. Troubleshooting communications errors can be expensive and time consuming, so BinMaster strongly encourages you to take adequate time in understanding and installing the RS-485 networks and to use quality cabling and connection techniques.

Summary of RS-485 requirements for BinMaster products:

- All devices must be wired or connected in a daisy-chain fashion.
- Use a quality twisted-pair cable with shield.
- Maintain correct polarity between all devices wired to the network cable.
- The two ends of the network cable must be terminated.
- Biasing must be applied in only one place anywhere along the cable or network.
- All devices on the network must support and be configured for the same protocol.

Wiring

> All devices on an RS-485 network must be connected directly to the network cable with no splits, taps or branch lines. The overall length of the cable must not exceed 4,000 feet or about 1,220 meters. Use a quality twisted-pair cable with shield and connect as per the wiring diagram in section 3.5. Observe the polarity of the wiring between all devices on the network, making sure that the wire connected to the + terminal at the console is also connected to the + terminal on all other devices. Likewise, make sure that the wires connected to the – and SH terminals at the C-console are also connected to the – and SH terminals, respectively, on all other devices. Do not connect the wires or shield to anything other than that specified.

Termination

> All BinMaster RS-485 networks must be terminated at both ends with a 120Ω resistor for proper operation and reliability. Normally this is done by the two devices connected at the very ends of the network cable. On some devices the termination is set ON or OFF by a slide switch labeled "NTR" and on other devices this may be set IN or OUT of circuit through a software menu.

> The C-50 SmartBob expansion console uses a switch labeled TERM for switching the termination resistor IN or OUT of the expansion network. It is located near the EX-485 terminal inside the lower compartment of the expansion console.

Bias Resistors

> All BinMaster RS-485 networks must have bias resistors installed or switched in for proper operation and reliability. This must be done at only one device but anywhere along the network cable.

> The C-100 SmartBob control console has bias resistors permanently switched in for the Expansion network, so there is nothing to do at the expansion consoles.

Protocol

All devices on an RS-485 network must be configured to use the same protocol for any communications to occur. The expansion network (EX-485) only supports one protocol and only the C-100 control console and the C-50 expansion consoles may be connected to it.

3.6 Lightning/Surge Protection

All electronic devices connected to a large wired network are susceptible to damage from lightning and other sources of electrical surges. Both the power source and an RS-485 network are a means for electrical surges to enter the C-50 SmartBob expansion console and do damage. Although some level of protection from electrical surges is built into the C-50, there are options to further protect your investment.

1. As recommended for the power connection at CN8, use an isolated power source and verify that the output is NOT grounded or referenced to earth. Make sure that all devices connected to either the SmartBob network or Expansion network uses a separate power source.

2. Be sure to connect the terminal at CN8 marked $\perp$ to a good quality earth using a 16 AWG size wire or larger. This wire should be as short as possible to earth with no sharp bends or loops in the wiring.

3. Use additional external lightning/surge arrestors on the RS-485 networks. This is very critical of large outdoor networks that are high off the ground. Place 1 to 3 surge arrestors on the RS-485 network evenly spaced apart, following the manufacturer's installation instructions and using a good quality connection to earth.

4. Consider using BinMaster wireless solutions that not only greatly protect your investment from lightning but can reduce installation time and eliminate the need for running long lengths of RS-485 cable. Call BinMaster and speak with one of our applications specialist for more information on our wireless solutions.

3.7 Wiring Diagram
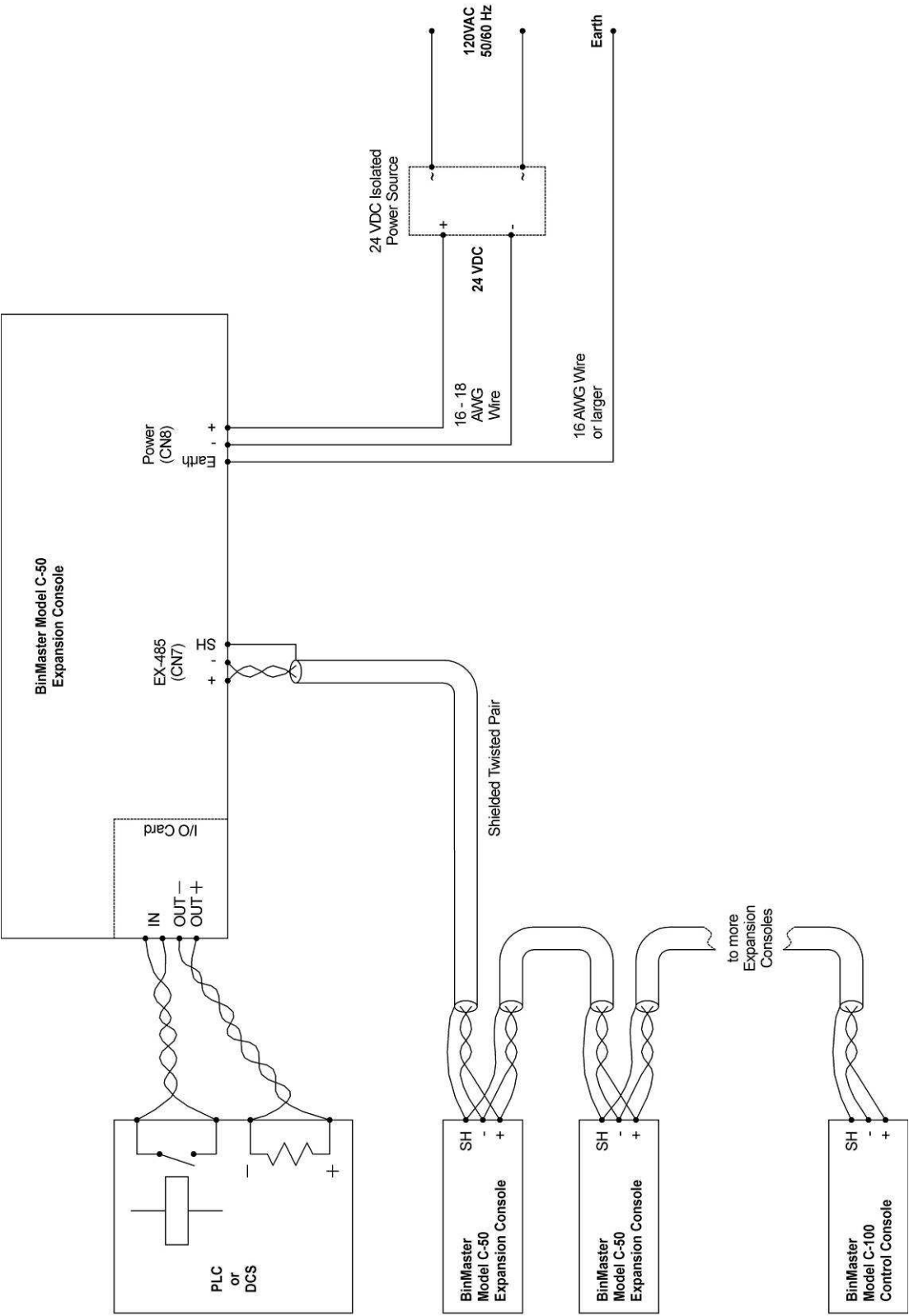
4.0 Assignments and Operation

The C-50 SmartBob expansion console is configured and operated by a C-100 SmartBob control console. After completing installation, wiring and switch settings as described in this manual, please refer to the *Model C-100 Operator's Manual* for detailed instructions on assigning ports to SmartBob sensors and operation.

5.0 Firmware Updates

The C-50 SmartBob expansion console has updateable Flash memory embedded within the system's microcontroller for storage of its operating software or firmware. Occasionally, BinMaster may release firmware updates due to general improvements or new features. These updates will be available to the customer and can be updated in one of two ways. One, the units can be shipped to us and updated by our Service Department for a small fee, see section 6.2 Technical Support, Customer Service and Repair. Or, the customer can apply the update themselves by following the instructions below.

5.1 Update Requirements

The following items are required to install a firmware update:

1. The electronic update file available from BinMaster. The update file will be free of charge to any existing BinMaster customer with a C-50 SmartBob console. This file may be delivered via an email attachment or downloaded via the BinMaster website.

2. A Windows or Linux PC with an RS-232 port. Optionally, a USB port with a USB to RS-232 adaptor may be used. Due to the short distance of this type of connection, a laptop may be preferred for performing the update at the console's mounted location. However, if it is required to move the console closer to a desktop PC, note that only the power and RS-232 connections are required for the update process.

3. A PC installation of Atmel's FLIP application downloaded from their website. This is the PC application that transfers the update file to the Flash memory.

4. A PC installation of the Java Runtime Environment. This is required by Atmel's FLIP application and is included with the Atmel FLIP download. Most PC's will already have this installed, if you know you already have it installed you can select the Atmel download package without this option.

5. A proprietary serial cable available from BinMaster for a small fee. Alternatively, a diagram for creating your own is shown below.
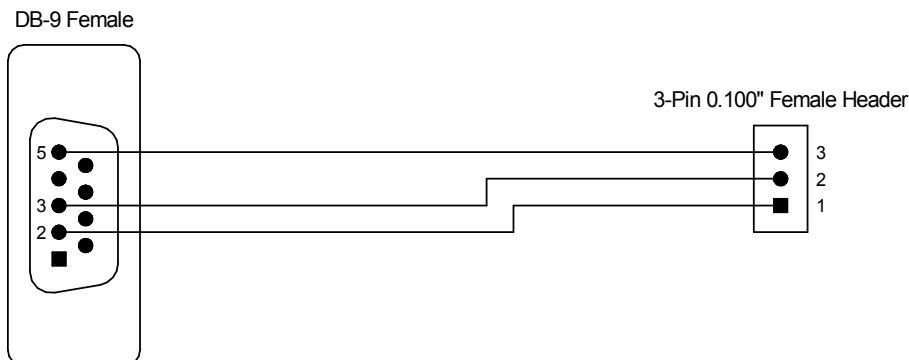
5.2 Download and Installation of Atmel's FLIP and Java Runtime Environment

The following steps will assist you in the required installation of Atmel's FLIP and the Java Runtime Environment:

1. Contact BinMaster to receive a link to the installer package for Atmel's FLIP and the Java Runtime Environment.

2. Save the installer to your desktop or another easily accessible location.

3. After download completes, execute or double-click the installer and follow its directions.

5.3 Update Procedure

After making sure you meet all the requirements in Section 5.1 and completing the installation of Atmel's FLIP in Section 5.2, follow these steps to update the console's firmware:

1. Connect the serial cable's DB-9 female connector to an available DB-9 male connection on the back of your PC.

2. Connect the serial cable's 3-pin female header to CN5 inside the wiring cabinet of the C-50 SmartBob expansion console. Make sure that pin 1 of the cable is connected to pin 1 of CN5. See following diagram.

3. Power up the C-50 SmartBob expansion console and boot the PC.

4. Locate the two pushbutton switches inside the wiring cabinet of the SmartBob console labeled S1 and S2. While depressing S1, momentarily press S2 and then release S1. The screen should go blank with the backlight still on.

5. Execute the Atmel FLIP application.

6. Open the BinMaster-supplied update file. Under the File menu, click on Load HEX File…, then navigate to and select the update file and click on Ok.

7. Under the Device menu, click on Select…, then locate and select AT89C51RE2 and click on Ok.

8. Under the Settings menu, click on Communication, then RS-232. Within the RS-232 Setup window, select the COMx port you are connected too and a Baudrate of 57600. Click on Ok.

9. Make sure Erase, Blank Check, Program and Verify are all checked under Operations Flow and click on Run.

10. After the process is complete and it reads "Verify PASS" in the status bar along the bottom, momentarily press S1. The SmartBob console should startup and display the new revision with date stamp.

6.0 Warranty and Service

6.1 Limited Warranty

The manufacturer warrants this equipment for twenty-four (24) months according to the following terms:

- This warranty extends to the original purchaser only and commences on the date of original purchase. The original purchaser must mail to the manufacturer the "Warranty Registration" card to confirm the equipment purchase. Failure to do so may void the warranty.

- The manufacturer will repair or replace any part of this equipment found to be defective, provided such part is delivered prepaid, to the factory. Manufacturer's obligation is limited to the cost of material and labor to repair or replace and does not include transportation expenses.

- This warranty shall not apply to any product that has, in our judgment, been tampered with, altered or subject to misuse, neglect or an accident. In addition, the warranty does not extend to repairs made necessary by normal wear.

- This warranty is in lieu of all other warranties, expressed or implied.

6.2 Technical Support, Customer Service and Repair

If you are in need of an updated operator's manual, specification drawing or parts replacement list, please visit our online documentation at www.binmaster.com.

Prior to shipping your Model C-50 back for either warranty or non-warranty repair; please call our service department for an RMA number.

Once an RMA number is provided, repairs should be shipped pre-paid to:

> BinMaster Service Dept
> Attn: RMA # xxxxxx
> 7201 North 98th Street
> Lincoln, NE 68507

You may call the customer service department for technical support, application assistance and to receive an RMA Monday through Friday from 8:00 am to 5:00 pm Central Time.

BinMaster, a division of Garner Industries, offers a toll-free telephone number (800) 278-4241 to our customer service department. International customers can call us at (402) 434-9102 or reach us via fax at (402) 434-9133.

7.0 Disposal

This product consists of materials that may be recycled by certain recycling companies. It uses recyclable materials and is designed to be easily separated. Consult local authorities for proper disposal locations.